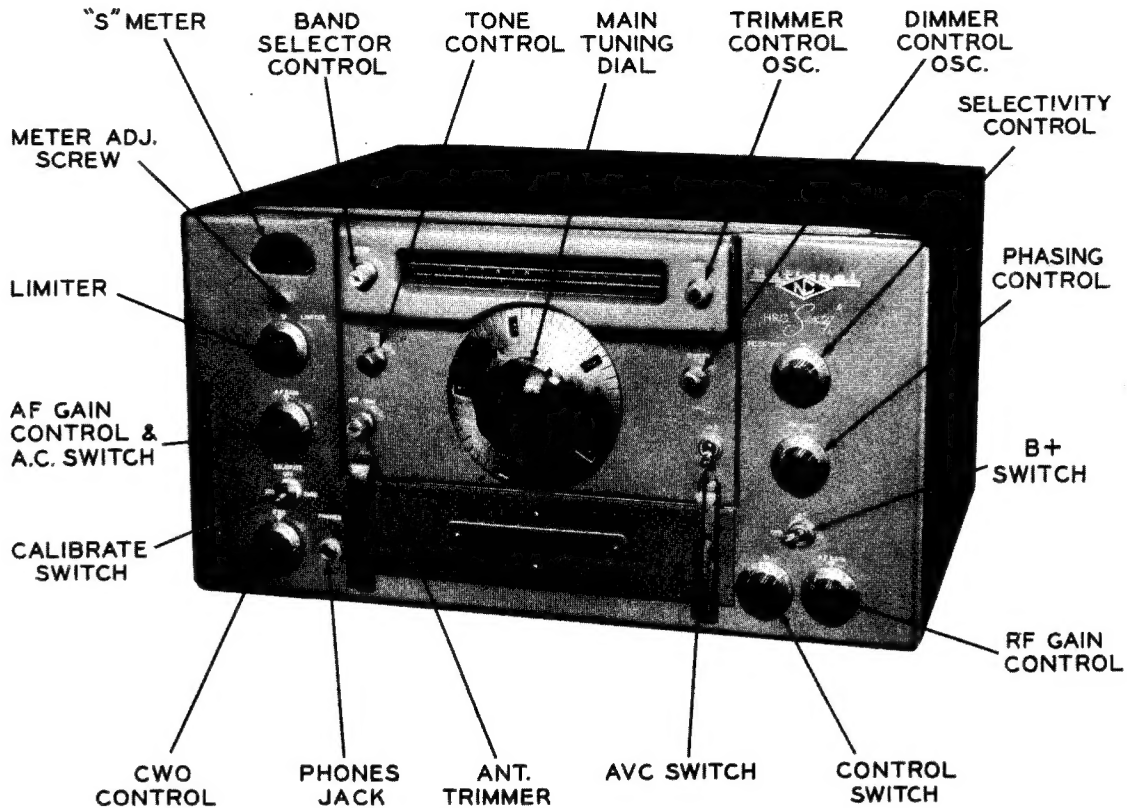




NATIONAL  
MODEL HRO-60



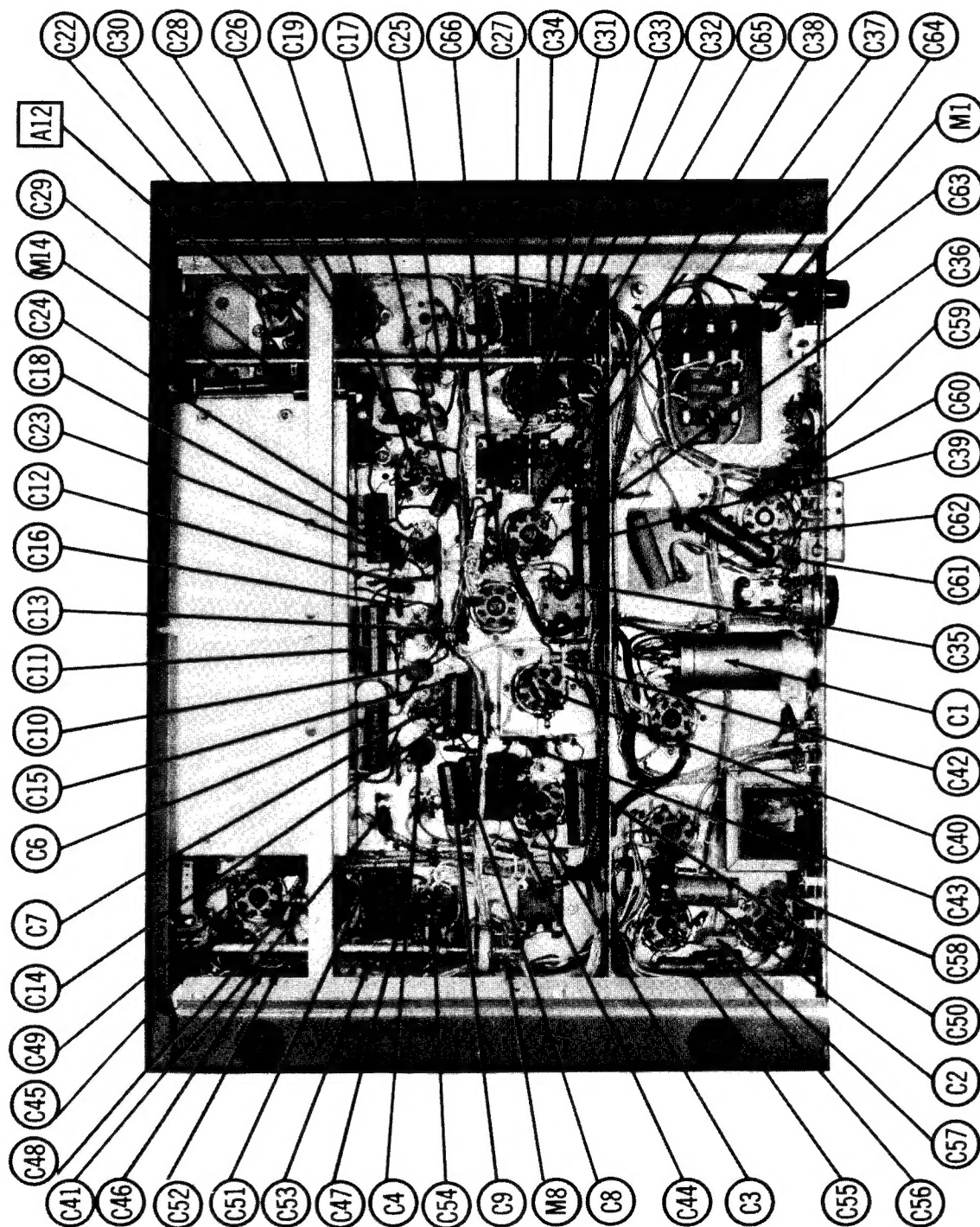
NATIONAL  
MODEL HRO-60

TRADE NAME	National Model HRO-60		
MANUFACTURER	National Co., Inc., 61 Sherman St., Malden 48, Mass.		
TYPE SET	AC Operated Multi-Band AM Superheterodyne Communications Receiver		
TUBES	Eighteen		
POWER SUPPLY	110-120 Volts AC	RATING	1.0 Amp@ 117 Volts AC
TUNING RANGES	Coil Set	General Coverage	Bandspread
	A	14-30MC	27.0-30.0MC
	B	7-14.4MC	14.0-14.4MC
	C	3.5-7.3MC	7.0-7.3MC
	D	1.7-4.0MC	3.5-4.0MC
	E	900-2050KC	
	F	480-960KC	
	G	180-430KC	
	H	100-200KC	
	J	50-100KC	
	AA		27.5-30MC
	AB	25.35MC	
	AC		21.0-21.5MC
	AD		50-54MC

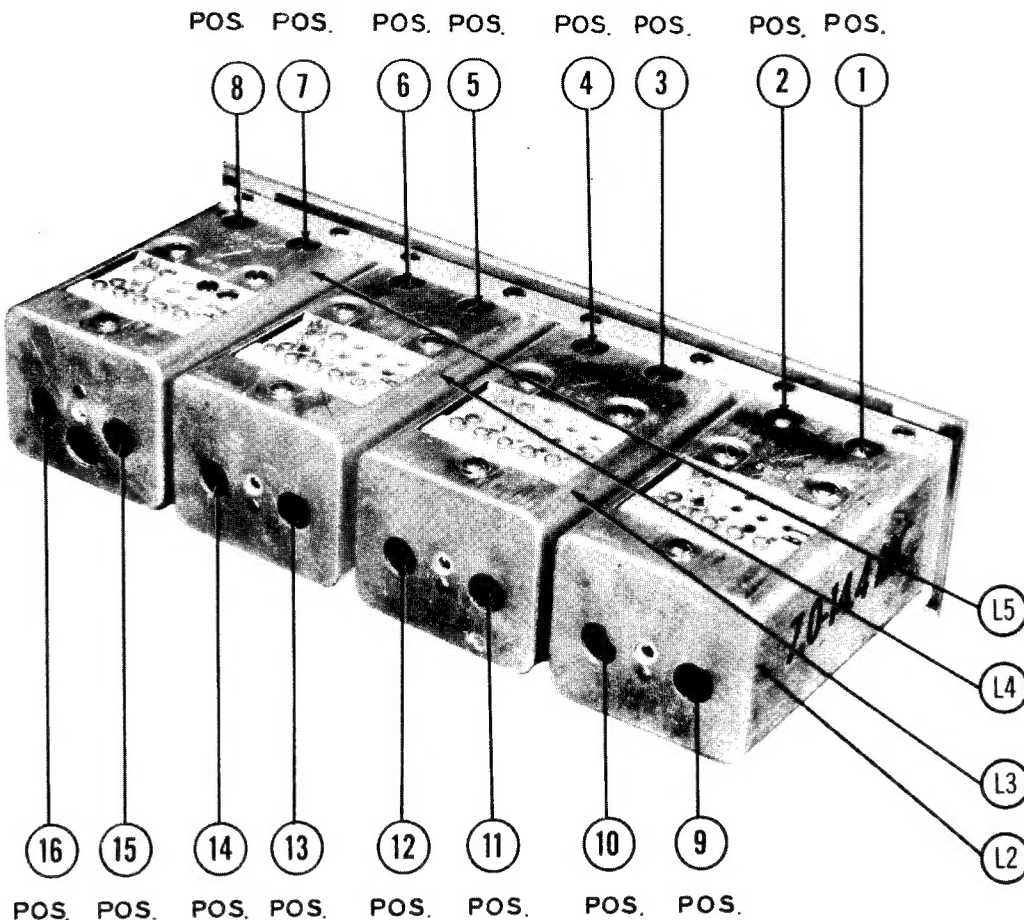
HOWARD W. SAMS & CO., INC. • Indianapolis 5, Indiana

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CHASSIS BOTTOM VIEW-CAPACITOR IDENTIFICATION

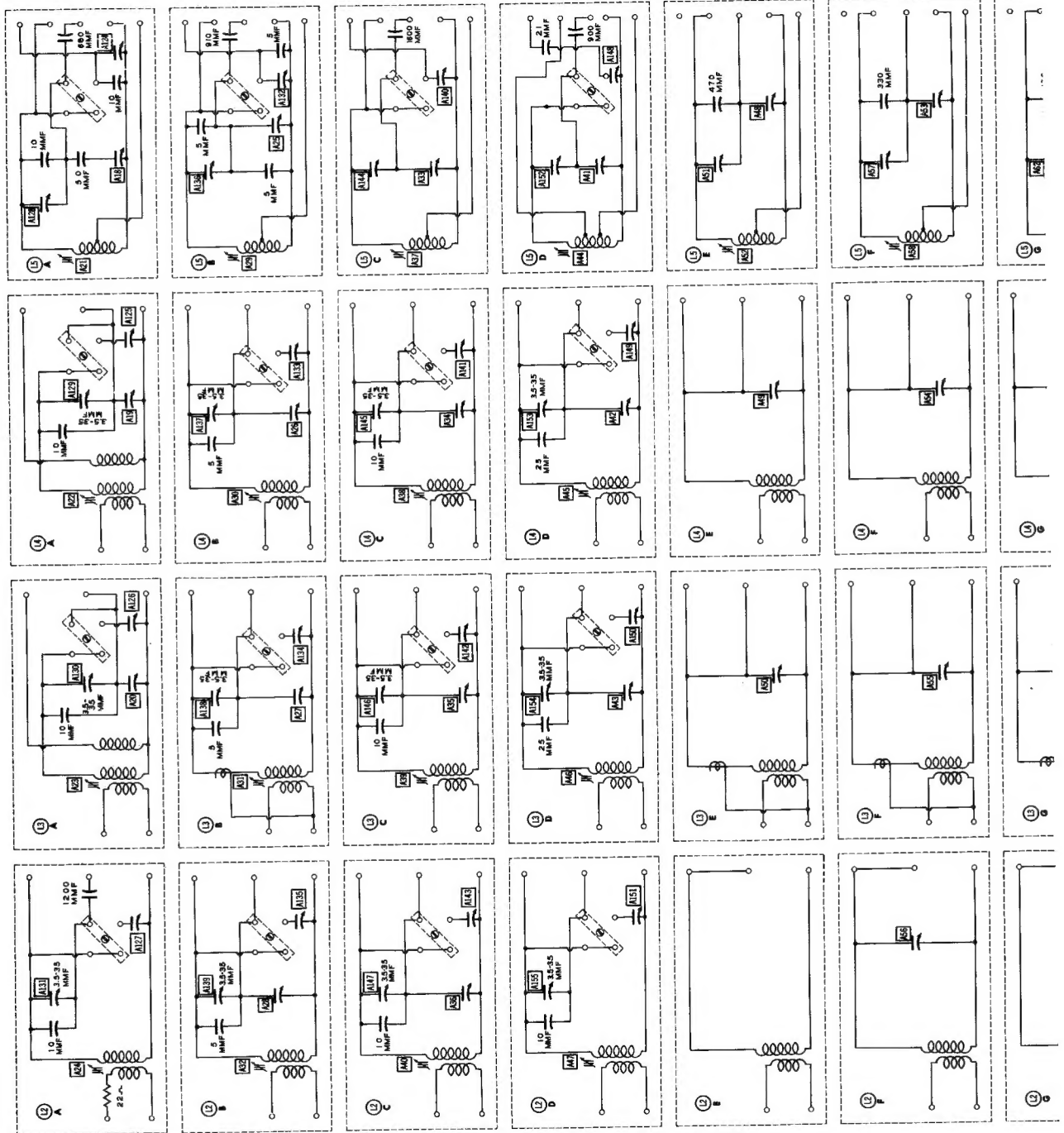


## PLUG-IN COIL SET

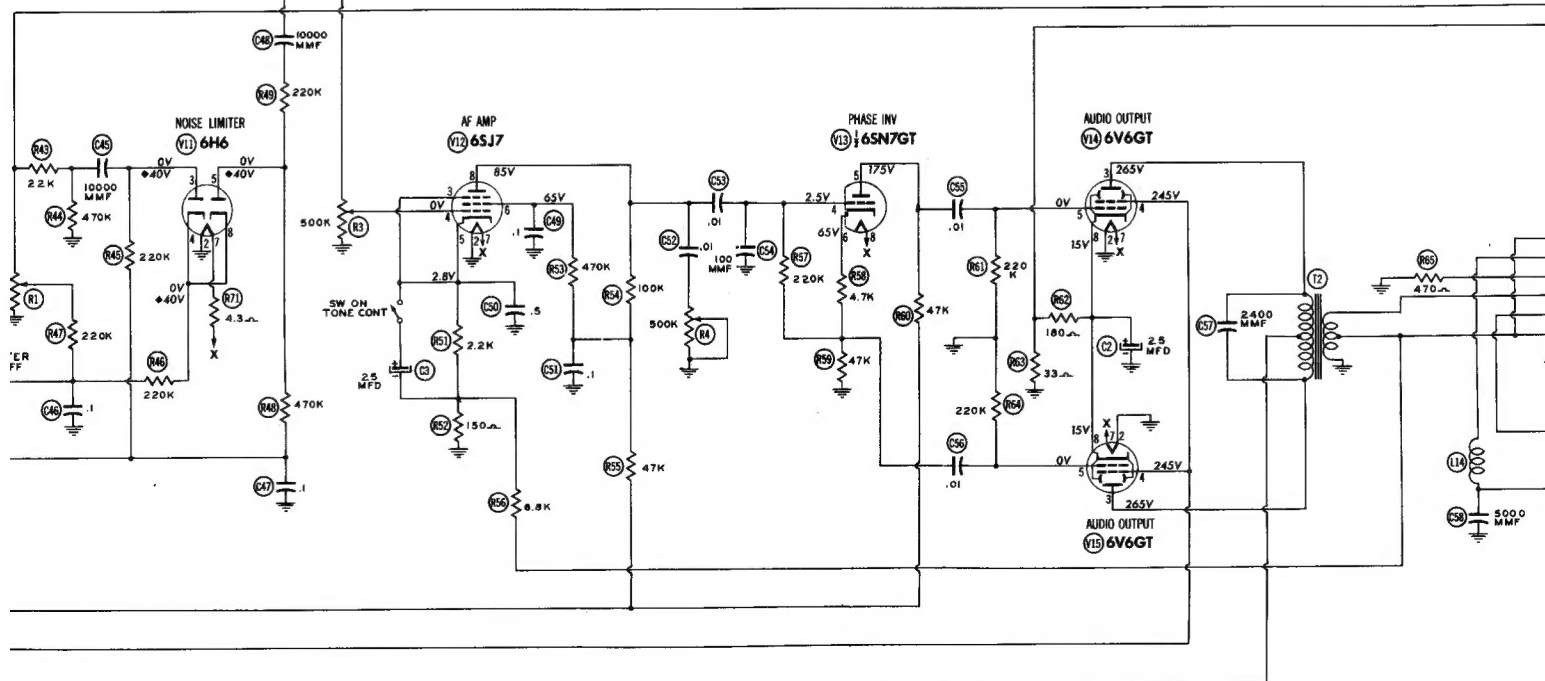
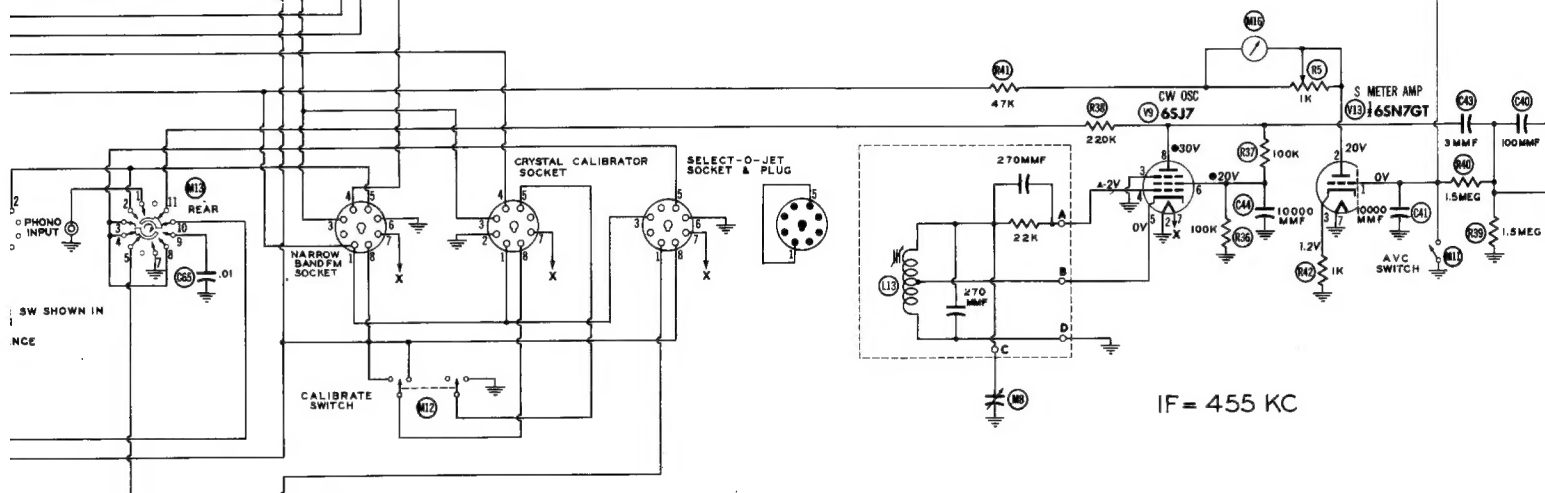
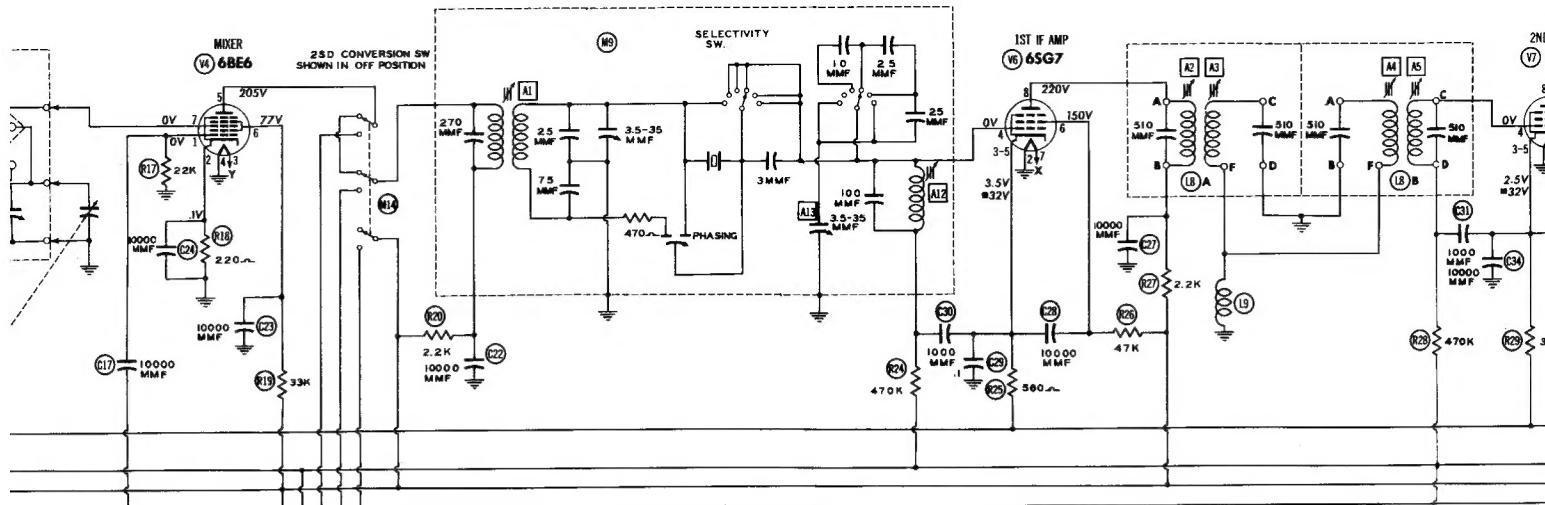
NOTE: INDUCTANCE ADJUSTMENTS AT POSITION NO. 16 ARE AS FOLLOWS:

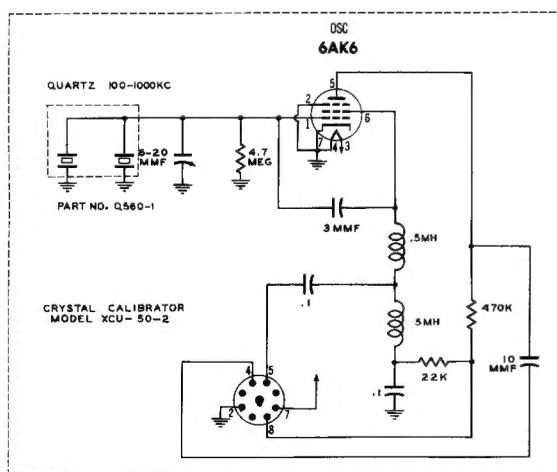
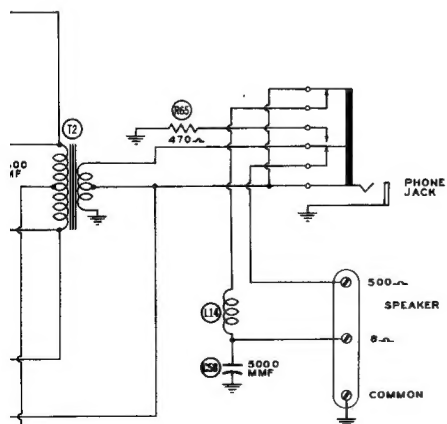
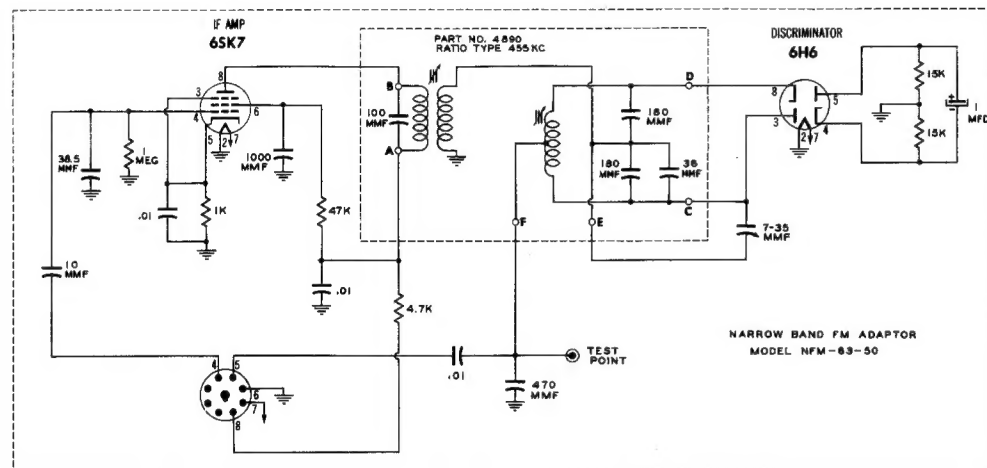
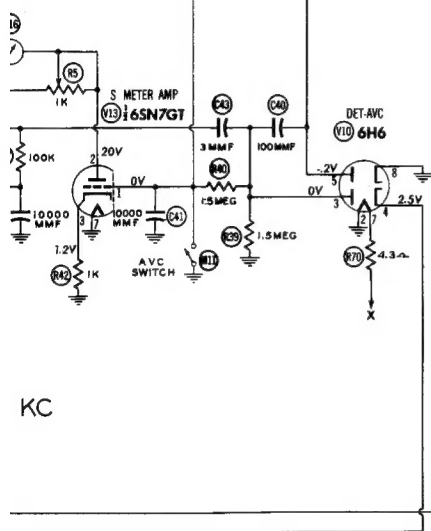
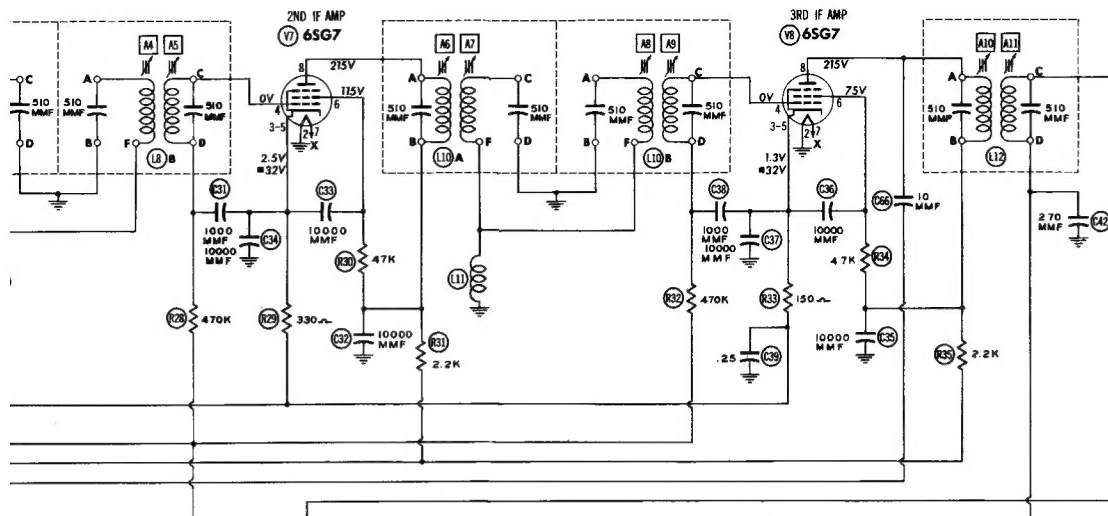
1. A, B & C Coil Sets --- Loop of wire inside coil form -- bending the loop one way or the other adds or subtracts to the inductance.
2. D Coil Set --- Adjustable disc inside coil form --- moving the disc toward the center of the coil decreases inductance.
3. E, F, G, H & J Coil Sets --- A short-circuited turn of wire around the outside of the coil --- moving this turn up or down varies the inductance.

Inductance adjustment at position Nos. 9, 11 & 13 of coil sets A, B, C, D, AA, AB, AC & AD is a loop of wire inside coil form --- bending the loop one way or the other varies the inductance.



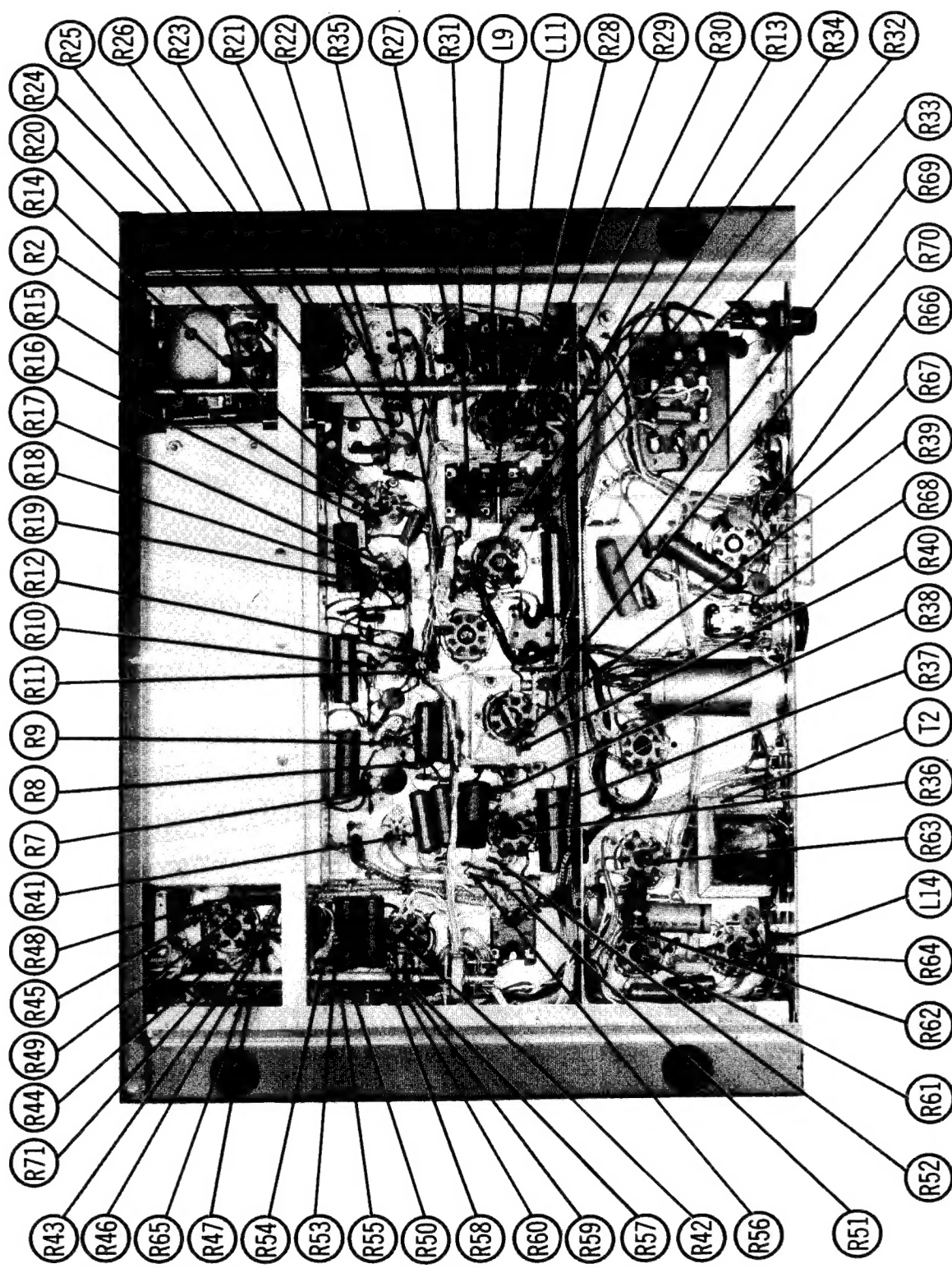






1. DC Voltage measurements are at 20,000 ohms per volt; AC Voltages measured at 1,000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of  $\pm 10\%$  in voltage and resistance readings.
6. Volume control at maximum, no signal applied for voltage measurements.





CHASSIS BOTTOM VIEW - RESISTOR IDENTIFICATION

NATIONAL  
MODEL HRO-60





## PARTS LIST AND DESCRIPTIONS (Continued)

## REPLACEMENT DATA

COILS (RF-IF) (CON 1)									
ITEM No.	USE	DC RES.		NATIONAL PART No.	MILLER PART No.	MEISSNER PART No.	IRC PART No.	NOTES	
		PRI.	SEC.						
L3A	1st.RF Trans.	.7Ω	0Ω	SA:6751				A Band, 14-30MC, tertiary winding-8.5Ω	
B	1st.RF Trans.	4.8Ω	.1Ω	SA:9258				B Band, 7-14.4MC	
C	1st.RF Trans.	9.2Ω	.2Ω	SA:6641				C Band, 3.5-7.3MC	
D	1st.RF Trans.	23Ω	.7Ω	SA:6637				D Band, 1.7-4MC	
E	1st.RF Trans.			SA:6540				E Band, 900-2050KC	
F	1st.RF Trans.			SA:6662				F Band, 480-960KC	
G	1st.RF Trans.			SA:6667				G Band, 180-420KC	
H	1st.RF Trans.			SA:6669				H Band, 100-200KC	
I	1st.RF Trans.			SA:6669				J Band, 50-100KC	
J	1st.RF Trans.			SA:9247				AA Band, 27-30MC	
K	1st.RF Trans.			SA:6616				AB Band, 25-35MC	
L	1st.RF Trans.			SA:8074				AC Band, 21-21.5MC	
M	1st.RF Trans.			SA:9262				AD Band, 50-54MC	
L4A	2nd.RF Trans.	.7Ω	0Ω	SA:6752				A Band, 14-30MC, Tertiary Winding-8.5Ω	
B	2nd.RF Trans.	.2Ω	.1Ω	SA:9259				B Band, 7-14.4MC	
C	2nd.RF Trans.	9.5Ω	.2Ω	SA:6642				C Band, 3.5-7.3MC	
D	2nd.RF Trans.	23Ω	.7Ω	SA:6638				D Band, 1.7-4MC	
E	2nd.RF Trans.			SA:6789				E Band, 900-2050KC	
F	2nd.RF Trans.			SA:6794				F Band, 480-960KC	
G	2nd.RF Trans.			SA:6800				G Band, 180-420KC	
H	2nd.RF Trans.			SA:6804				H Band, 100-200KC	
I	2nd.RF Trans.			SA:6810				J Band, 150-100KC	
J	2nd.RF Trans.			SA:9248				AA Band, 27-30MC	
K	2nd.RF Trans.			SA:6676				AB Band, 25-35MC	
L	2nd.RF Trans.			SA:8075				AC Band, 21-21.5MC	
M	2nd.RF Trans.			SA:9265				AD Band, 50-54MC	
L5A	HF Osc. Coil	0Ω		SA:9254				A Band, 14-30MC, tapped	
B	HF Osc. Coil	.1Ω		SA:9254				B Band, 7-14.4MC, tapped	
C	HF Osc. Coil	.2Ω		SA:6760				C Band, 3.5-7.3MC, tapped	
D	HF Osc. Coil	.7Ω		SA:6676				D Band, 1.7-4MC, tapped @.3Ω and @.3Ω	
E	HF Osc. Coil			SA:6631				E Band, 900-2050KC	
F	HF Osc. Coil			SA:6795				F Band, 480-960KC	
G	HF Osc. Coil			SA:6785				G Band, 180-420KC	
H	HF Osc. Coil			SA:6805				H Band, 100-200KC	
I	HF Osc. Coil			SA:6811				J Band, 50-100KC	
J	HF Osc. Coil			SA:9249				AA Band, 27-30MC	
K	HF Osc. Coil			SA:9235				AB Band, 25-35MC	
L	HF Osc. Coil			SA:9268				AC Band, 21-21.5MC	
M	HF Osc. Coil			SA:9267				AD Band, 50-54MC	
L6	200KC IF Trans.	.9Ω	.9Ω	SA:9205				Includes .0001MFD cap. & 22KΩ resistor; tapped @.1Ω	
L7	1555KC Osc. Coil			SA:9203					
L8A	2nd.IF Trans.	2.2Ω	2.4Ω	SA:8448				Part of L8A	
B	2nd.IF Trans.	2.2Ω	2.4Ω	SA:6072				1.1 Microhenries	
L9	RF Choke	0Ω		SA:8448					
L10A	3rd.IF Trans.	2.2Ω	2.4Ω	SA:8448				Part of L10A	
B	3rd.IF Trans.	2.2Ω	2.4Ω	SA:6072				1.1 Microhenries	
L11	RF Choke	0Ω		SA:3353				Includes 22KΩ resistor & 270MMF cap.; tapped @.8Ω	
L12	4th.IF Trans.	2.4Ω	2.5Ω	SA:9393					
L13	BFO Coil	4Ω		SA:9392					
L14	Speaker Output Choke	0Ω		SA:9392				1 Microhenry	CLA

## CONTROLS

.16	B HF Osc. Coll	D Band, 1.7-4.0MC, tapped
.23	C HF Osc. Coll	E Band, 900-2050KC
.712	D HF Osc. Coll	F Band, 480-960KC
	E HF Osc. Coll	G Band, 180-420KC
	F HF Osc. Coll	H Band, 100-200KC
	G HF Osc. Coll	I Band, 50-100KC
	H HF Osc. Coll	J Band, 27-30MC
	I HF Osc. Coll	AA Band, 25-35MC
	J HF Osc. Coll	AB Band, 25-35MC
	K HF Osc. Coll	AC Band, 21-21.5MC
	L HF Osc. Coll	AD Band, 50-54MC
.9Q	M HF Osc. Coll	
	L6 200KC IF	
	Trans.	
.9Q	L7 1555KC Osc. Coll	
		Includes .0001MFD cap.

FUSES									
ITEM No.	TYPE	RATING	REPLACEMENT DATA						
			NATIONAL PART No.		LITTELFUSE PART No.		BUSS PART No.		
			FUSE	HOLDER	FUSE	HOLDER	FUSE	HOLDER	
L6A	2nd-IF Trans.	2.2Ω	2.4Ω	SA:8448					
B	2nd-IF Trans.	2.2Ω	2.4Ω						
L9	Input	2.2Ω	2.4Ω						
L10	RF Choke	001		SA:6072					
L10A	3rd-IF Trans.	2.2Ω	2.4Ω						
B	3rd-IF Trans.	2.2Ω	2.4Ω						
L11	Output	2.2Ω	2.4Ω						
L11	RF Choke	001		SA:6072					
L12	4th-IF Trans.	2.4Ω	2.5Ω	SA:3353					
L13	BFO Coil	4Ω		SA:9193					
L14	Speaker Output Choke	002		SA:3992				CLA	1 Microhenry
Part of L8A 1.1 Microhenries									
Part of L10A 1.1 Microhenries									
Includes 22KΩ resistor & 270MMF cap.; tapped ② - 8Ω									

# PARTS LIST AND DESCRIPTIONS (Continued)

## DIAL LIGHTS

ITEM No.	BASE TYPE	VOLTS	AMPS.	REPLACEMENT DATA		NOTES
				NATIONAL PART No.	BEAD COLOR	
M2	Bayonet	3-8	.15	F136-6	Brown	Type #47
M3	Bayonet	3-8	.15	F136-6	Brown	Type #47
M4	Bayonet	3-8	.15	F136-6	Brown	Type #47

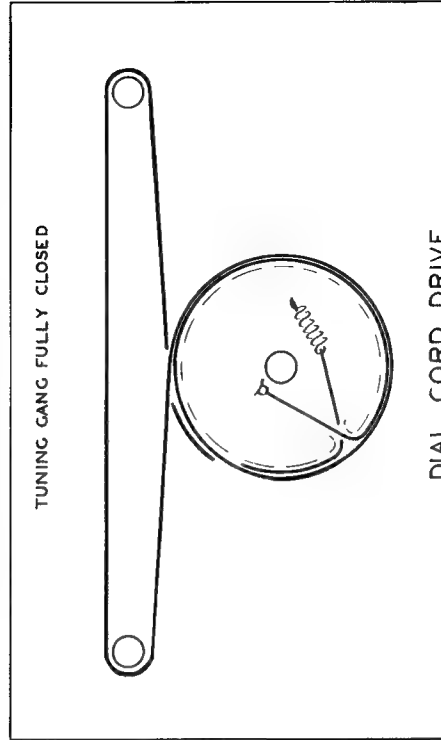
## MISCELLANEOUS

ITEM No.	PART NAME	NATIONAL PART No.	NOTES
M5	Tuning Capacitor	SA8687	Main (4 Sections)
M6	Tuning Capacitor	J957-31	Oscillator
M7	Tuning Capacitor	J957-32	Antenna
M8	Coil	SA9202	CW Osc. Adj.
M9	Trimmer	H500-6	IF Primary
	Capacitor	D825D-411	IF Input
	Capacitor	25MMF 500VDC	75MMF 500VDC
	Trimmer Capacitor	D825C-301	Mica Variable 3.5-35MMF
	Crystal	D832-2	455KC
	Capacitor	E979-1	3MMF 500VDC
	Variable Capacitor	D825D-449	Phasing Control
	Switch	SA9190	Selectivity
	Capacitor	E195-1	3.5-35MMF Mica
	Capacitor	D832-2	10MMF 500VDC
M10	Capacitor	D825D-426	25MMF 500VDC
	Capacitor	D825D-411	25MMF 500VDC
	Coil	SA9201	IF Output
	Resistor	J569-21	470Ω 2 watt
	Switch	E230-2	B+ On/Off
	Switch	E230-2	AVC
	Switch	P738-1	Calibrate
	Switch	SA6564	Function Selector
	Switch	R027-1	2nd. Conversion On/Off
	Switch	H340-4	T1 Primary Selector
M11	Meter	J984-5	Signal Meter 0-1MA with "S" scale
	Dial Scale	P136-15	Band "A"
	Dial Scale	P136-16	Band "B"
	Dial Scale	P136-3	Band "C"
	Dial Scale	P136-4	Band "D"
	Dial Scale	P136-17	Band "A" (Bandspread only)
	Dial Scale	P136-18	Band "B" (Bandspread only)
	Dial Scale	P136-7	Band "C" (Bandspread only)
	Dial Scale	P136-8	Band "D" (Bandspread only)
	Dial Scale	P136-9	Band "E" and "F"
M12	Dial Scale	P136-10	Band "G" and "H"
	Dial Scale	P136-11	Band "J"
	Dial Scale	P136-12	Band "K"
	Dial Scale	P136-13	Band "AA"
	Dial Scale	P136-14	Band "AB"
	Dial Scale	P136-15	Band "AC"
	Dial Scale	P136-16	Band "AD"
	Knob	SA7021	Tone, antenna trimmer and dimmer controls (3 Used)
	Knob	SA6868	Crystal phasing and CW Osc. Controls (2 Used)
	Knob	SA6869	Selectivity Control
M13	Knob	SA6870	Limiter Control
	Knob	SA6871	AF Gain Control
	Knob	SA6867	RF Gain Control
	Knob	SA6587	Function Selector
	Knob	SA6586	Main Tuning
	Knob	Q534-2	
	CW Osc. Shift		

## RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V 1	6BA6	3.5Meg	100Ω	.1Ω	0Ω	1500Ω	100Ω	100Ω	
V 2	6BA6	3.5Meg	560Ω	.1Ω	0Ω	1500Ω	100Ω	560Ω	
V 3	6CA	17.7KΩ	0Ω	1.8Ω	0Ω	17.7KΩ	22KΩ	0Ω	
V 4	6BE6	22KΩ	220Ω	1.8Ω	0Ω	11KΩ	135KΩ	.1Ω	
V 5	6BE6	22KΩ	.2Ω	0Ω	.1Ω	12.8KΩ	100KΩ	.1Ω	
V 6	6SG7	0Ω	0Ω	5600Ω	3.5Meg	5600Ω	150KΩ	.1Ω	12.8KΩ
V 7	6SG7	0Ω	0Ω	5400Ω	3.5Meg	5400Ω	150KΩ	.1Ω	12.8KΩ
V 8	6SG7	0Ω	0Ω	5200Ω	3.5Meg	5200Ω	150KΩ	.1Ω	12.8KΩ
V 9	6SG7	0Ω	0Ω	5000Ω	3.5Meg	5000Ω	150KΩ	.1Ω	12.8KΩ
V 10	6H6	0Ω	0Ω	1.5Meg	120KΩ	120KΩ	100KΩ	.1Ω	150KΩ
V 11	6H6	0Ω	0Ω	1.1Meg	220KΩ	220KΩ	100KΩ	.1Ω	150KΩ
V 12	6H6	0Ω	0Ω	1.1Meg	220KΩ	220KΩ	100KΩ	.1Ω	150KΩ
V 13	6H6	0Ω	0Ω	1.1Meg	220KΩ	220KΩ	100KΩ	.1Ω	150KΩ
V 14	6V6GT	0Ω	0Ω	1180Ω	1300Ω	220KΩ	100KΩ	.1Ω	150KΩ
V 15	6V6GT	0Ω	0Ω	1160Ω	1300Ω	220KΩ	100KΩ	.1Ω	150KΩ
V 16	5V4G	INF	100KΩ	INF	115Ω	INF	120Ω	INF	100KΩ
V 17	0B2	17KΩ	0Ω	INF	0Ω	17KΩ	154KΩ	0Ω	150KΩ
V 18	4H-4	INF	.7Ω	INF	INF	INF	INF	1.5Ω	INF

FUNCTION SWITCH IN "AM" POSITION UNLESS NOTED  
 LIMITER IN "OFF" POSITION UNLESS NOTED  
 B+ SWITCH IN "ON" POSITION  
 CALIBRATE SWITCH IN "OFF" POSITION  
 AVC SWITCH IN "ON" POSITION UNLESS NOTED  
 RF GAIN CONTROL FULLY COUNTERCLOCKWISE UNLESS NOTED  
 † MEASURED FROM PIN 2 OF V16  
 ‡ AVC SWITCH IN "CW" POSITION  
 † LIMITER SWITCH IN "OFF" POSITION  
 ‡ RF GAIN CONTROL AT ZERO



# ALIGNMENT INSTRUCTIONS

## MAIN TUNING DIAL

The main tuning dial should normally give no trouble. If, however, the dial should become removed from the receiver it must not be operated until mounted on the capacitor shaft with set screws tight. This is because the dial is only designed to rotate for ten revolutions (0 to 500) and if turned farther than this the mechanism will be damaged. When mounted on the capacitor, limit stops protect the dial. The procedure for remounting the dial is as follows:

1. Place the dial on the capacitor shaft, tighten set screws and turn the dial counter clockwise to fully mesh capacitor rotor plates so that the tips of the rotor plates are flush with the edges of the stator plates.
2. Loosen set screws and rotate dial slowly until the dial reading has decreased to zero.
3. Tighten the set screws.
4. Check position of rotor plates at zero. The tips of the rotor plates must be flush with the edge of the stator plates. A slight adjustment may be necessary and this is done by loosening the set screws, adjusting the position of the dial and tightening the set screws again.

If it is necessary to remove the dial at any future time, turn to 250 before removing the dial and do not disturb the setting of either the dial or capacitor until reassembled. If in doubt about the correct position, inspect the springs on the back of the dial. When the dial reads 250 these springs should be straight up and down, they must not be tipped to one side.

It is important that the backplate and dial do not become separated. The backplate is held in place by two springs so that its gear teeth mesh with the dial gear teeth in correct relationship for proper dial operation. If this backplate should be sprung out of place, it may return to an incorrect position and the proper dial numbers will not appear in the windows when the dial is used. To ascertain that the two parts are in correct position proceed as follows:

1. Locate small window near outer periphery of dial backplate and also locate dial number window on face of dial which is 180 degrees removed from the small backplate window.
2. Hold dial so backplate lies flat in palm of left-hand and with right hand rotate dial knob until 250 appears in previously located dial window.
3. If dial is properly adjusted it will be noted that the pointer at the outer edge of the small window lines up with a marked tooth on the dial itself. It will be found that the dial and backplate can be moved so that the backplate pointer will mesh between teeth at points equidistant from marked tooth in either direction.
4. If by checking as in paragraph 3 the dial is found not properly adjusted, it will be necessary to separate the backplate from the dial far enough to bring the two gears out of mesh and the re-mesh the two parts until the proper setting is found. A number of trial settings may be required before the correct mesh is found.

## SLIDE RULE TUNING DIAL

The slide-rule tuning dial assembly has been adjusted at the factory for accurate synchronization with the micrometer dial. If not tampered with this mechanism will provide complete freedom of mechanical trouble over a long period of continuous use. It is driven by an anti-backlash tuning gear ganged with the main tuning dial. The slide-rule dial pointer is controlled by a string drive assembly.

If replacement of the string drive cord is required it will be necessary to remove the receiver chassis from its cabinet wraparound. Before removing the micrometer dial reference should be made to preceding paragraph for proper method of removal. Refer to the dial cord stringing diagram for the proper method of replacing the cord. After the cord has been replaced and before the receiver is returned to its cabinet the micrometer dial should temporarily be replaced and the slide-rule pointer correctly set in the following manner:  
(NOTE: This procedure may also be used if a check is desired to assure that the slide-rule dial pointer is properly synchronized with that of the main tuning dial.)

1. Check the main tuning dial at zero on its dial scale. The tips of the rotor plates should be flush with the edge of the stator plates.
2. Set the Band Selector control so that the D coil set scale appears.
3. Set the main tuning dial at 490 on its dial scale. Connect setting of the slide-rule dial pointer is 4 megacycles on the dial scale. Draw the slide rule pointer along the cord to its proper position being careful not to disturb the setting of the micrometer dial. After the correct setting has been obtained and use a small amount of glyptol or household cement to fasten the dial pointer securely in place on the cord.

## ALIGNMENT INSTRUCTIONS

This receiver has been accurately calibrated by the manufacturer and is very stable. Realignment should not be necessary unless the receiver has been tampered with or unless component parts or tubes have been replaced. It is preferred that the individual aligning the receiver be one who is familiar with communication receivers and experienced with alignment there of.

To determine if IF Alignment is needed the following check should be performed:

1. Adjust the receiver for normal operation with the antenna disconnected.
2. Connect a pair of headphones to the phones jack.
3. Set the AVC switch at OFF.
4. Set the control switch to CW.
5. Set the phasing control at ZERO.
6. Set the crystal selectivity switch at "5".
7. Set the RF gain control at "10".

The AF gain control may be adjusted to a comfortable listening level and will not affect results.

Adjust the CWO control to a point where the predominate pitch of the background noise is lowest and a distinct ring of the crystal is heard. Note the setting of the CWO control.

Turn the crystal selectivity switch to OFF, and again adjust the CWO control for lowest pitch of background noise.

Compare this setting with the previous setting.

If the two settings are identical, the IF is properly aligned at the crystal frequency. If they are not identical perform IF amplifier alignment.

## SECOND CONVERSION IF ALIGNMENT

The second conversion IF frequency of this receiver is 455KC plus or minus 2KC. The exact frequency is determined by the resonant frequency of the crystal in the crystal filter assembly.

Plug in the D range coil set.

Connect the high side of a signal generator output lead to the stator of the mixer section of the tuning gang. Connect the low side to the tuning gang frame.

Connect an output meter across the output terminals.

Set the control switch to CW.

Set the AVC switch to OFF.

Set the phasing control at ZERO.

Set the selectivity switch at "5".

Set the AF gain control at "10".

Set the RF gain control at "9".

Set the signal generator at approximately 455KC with the modulation off.

Set output of the generator to obtain approximately 100 microvolts.

Turn the CWO control to obtain a beat between 400 and 1000 cycles. The presence of the beat note may be checked by temporarily connecting a pair of phones to the phone jack. If difficulty is encountered in obtaining a beat note, adjust the BFO coil slug, A14.

Slowly vary the signal generator frequency between 453 and 457KC. Somewhere between these limits the output will show a sharp peaked increase, this is the frequency of the crystal, and the frequency to which the second conversion IF is aligned.

Turn the selectivity switch at "1".

Turn the control switch to "AM".

Turn the signal generator modulation ON.

	DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	BAND SWITCH POS.	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS
1.	Direct	High side to stator on mixer section of tuning gang. Low side to tuning gang frame.	IF Crystal freq. (See note above) (400-Mod)	Coil set "D".	Point of non-interference	Across output terminals.	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11	Adjust for maximum output. Attenuate signal generator to prevent overloading. The order of adjustment is not important.
2.	"	"	IF Crystal freq. plus 2KC.	"	"	"	A12	Adjust for maximum output.
3.	"	"	IF Crystal freq. (Same as step 1).	"	"	"	A13	"
4.	"	"	"	"	"	"	A14	Turn the selector switch to "CW". Adjust the CWO control to obtain zero beat. If zero beat does not occur at "0" on the CWO control knob, set knob at "0" and adjust A14 for zero beat.

NATIONAL  
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## FIRST CONVERSION CONVERTER ALIGNMENT

Leave the signal generator connected as during Second Conversion IF Alignment.  
Set the control switch to AM.  
Set the AVC switch to OFF.  
Set the phasing control at ZERO.  
Set the selectivity switch at OFF.  
Set the AF gain control at "10".  
Set the RF gain control at "9".  
Plug in the "B" range coils.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	BAND SWITCH POS.	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS
5. Direct	High side to stator of mixer section of tuning gang. Low side to frame of tuning gang.	2010KC (400%Mod)	Coil set "B".	Point of non-interference.	Across output terminals.	A15	Adjust for a distinct peak on the output meter. If A15 is badly misadjusted more than one peak may be found. The correct peak will be of much higher amplitude than any of the spurious peaks.
6. "	"	"	"	"	"	A16, A17	Adjust for maximum output.

## GENERAL COVERAGE OSC. &amp; RF ALIGNMENT

The general coverage portion of this receiver has been properly aligned at the factory, using precision crystal controlled signal generators. Alignment should not be attempted unless proper precision equipment is available.  
The need for realignment of the high frequency oscillator is indicated by the calibration being off more than 1% at the high frequency end of the dial scale.

Particular care must be exercised when adjusting the HF oscillator trimmer in each coil set. Three different checking procedures must be followed.

The coil sets below 7MC must be adjusted so the oscillator frequency is higher than the RF frequency. The image frequency should be 910KC below the signal frequency on the dial.

The oscillator for frequencies between 7MC and 35MC is set to the higher frequencies, but the image is 4020KC below the signal frequency. In some cases this frequency will be off the lower range of the coil set. In these cases special procedure must be used to check for the image.

In the 50MC to 54MC coil set, the oscillator must be adjusted to a frequency lower than the RF frequency.

The following methods should be used to ascertain that the oscillator is correctly adjusted on all coil sets:

1. When adjusting the oscillator in the coil sets below 7MC, the receiver should be tuned to a frequency 910KC below the RF frequency, at which point the image should appear. If it does not the oscillator trimmer should be decreased in capacity until the fundamental and image frequencies appear in correct positions on the dial.

2. When adjusting the oscillator on coil sets between 7MC and 35MC, the image must appear 4020KC below the RF frequency. In the cases where this frequency is beyond the range of the coil set, the receiver dial should be left at the proper frequency and the signal generator tuned to 4020KC above the RF frequency. It may be necessary to increase the generator output considerably to receive the image. The image must appear at the present dial position for proper oscillator tracking.

3. The oscillator for the AD coil set must be adjusted to the low frequency side of the RF signal. In this instance the image must be located 4020KC above the RF frequency. Leave the receiver tuned to the RF frequency and tune the generator 4020KC lower than the RF frequency. It may be necessary to increase the generator output to obtain the image. If the image is not present at this point the oscillator is not correctly adjusted.

Set the control switch to AM.

Set the AVC switch to OFF.

Set the RF gain control to "10".

Set the bandspread switches to general coverage.

Set the AF gain control to provide a suitable output level.

Check the position of the antenna trimmer and oscillator trimmer knobs. They should be set with the arrow pointing straight up.

Correction of tracking errors in the RF and mixer stages at the low frequency end of each coil set is accomplished by adjustment listed in the table. The actual tracking may be checked by pressing the end plates of the tuning gang sections either closer or away from the adjacent plate (do not bend plate enough so that it will not spring back to its original position). A change in capacity in either direction should decrease the output.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	BAND SWITCH POS.	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS
7. 270Ω Carbon Resistors	High side thru 270Ω to antenna terminal. Low side to chassis.	30MC (400%Mod)	Plug in coil set "A".	30MC	Across voice coil.	A18 (pos 8) A19 (pos 6) A20 (pos 4)	Adjust in order given for maximum output.
8. "	"	14.4MC	"	14.4MC	"	A21 (pos 16) A22 (pos 13) A23 (pos 11) A24 (pos 9)	Adjust in order given for max. output. Repeat steps 1 & 2 until no further improvement can be made.
9. "	"	14.4MC	Plug in coil set "B".	14.4MC	"	A25 (pos 8) A26 (pos 6) A27 (pos 4) A28 (pos 2)	Adjust in order given for maximum output.
10. "	"	7.0MC	"	7.0MC	"	A29 (pos 16) A30 (pos 13) A31 (pos 11) A32 (pos 9)	Adjust in order given for max. output. Repeat steps 9 & 10 until no further improvement can be made.
11. "	"	7.3MC	Plug in coil set "C".	7.3MC	"	A33 (pos 8) A34 (pos 6) A35 (pos 4) A36 (pos 2)	Adjust in order given for max. output.
12. "	"	3.5MC	"	3.5MC	"	A37 (pos 16) A38 (pos 13) A39 (pos 11) A40 (pos 9)	Adjust in order given for max. output. Repeat steps 11 & 12 until no further improvement can be made.
13. "	"	1.8MC	Plug in coil set "D".	1.8MC	"	A41 (pos 8) A42 (pos 6) A43 (pos 4)	Adjust in order given for max. output.
14. "	"	4.0MC	"	4.0MC	"	A44 (pos 16) A45 (pos 13) A46 (pos 11) A47 (pos 12)	Adjust in order given for max. output. Repeat steps 13 & 14 until no further improvement can be made.
15. "	"	2.0MC	Plug in coil set "E".	2.0MC	"	A48 (pos 8) A49 (pos 6) A50 (pos 4)	Adjust in order given for max. output.
16. "	"	1 MC	"	1 MC	"	A51 (pos 7)	Adjust for max. output.
17. "	"	1.4MC	"	1.4MC	"	A52 (pos 16)	Adjust for max output. Repeat steps 15, 16 & 17 until no further improvement can be made.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	BAND SWITCH POS.
18. "	"	.9MC	Plug in coil set "F".
19. "	"	.5MC	"
20. "	"	.7MC	"
21. "	"	400KC	Plug in coil set "G".
22. "	"	200KC	"
23. "	"	300KC	"
24. "	"	200KC	Plug in coil set "H".
25. "	"	100KC	"
26. "	"	150KC	"
27. "	"	100KC	Plug in coil set "J".
28. "	"	50KC	"
29. "	"	75KC	"
30. "	"	30MC	Plug in coil set "AA".
31. "	"	27.2MC	"
32. "	"	28MC	"
33. "	"	35MC	Plug in coil set "AB".
34. "	"	25MC	"
35. "	"	30MC	"
36. "	"	21.5MC	Plug in coil set "AC".
37. "	"	21MC	"
38. "	"	21.3MC	"
39. "	"	54MC	Plug in coil set "AD".
40. "	"	50MC	"
41. "	"	52MC	"



# CTIONS (CONT.)

IO LING	OUTPUT METER	ADJUST	REMARKS
"	"	A53 (pos. 8) A54 (pos. 6) A55 (pos. 4) A56 (pos. 2)	Adjust in order given for max. output.
"	"	A57 (pos. 7)	Adjust for max. output.
"	"	A58 (pos. 16)	Repeat steps 18, 19, & 20 until no further improvement can be made.
"	"	A59 (pos. 8) A60 (pos. 6) A61 (pos. 4)	Adjust in order given for max. output.
"	"	A62 (pos. 7)	Adjust for max. output.
"	"	A63 (pos. 16)	Adjust for max. output. Repeat steps 21, 22 & 23 until no further improvement can be made.
"	"	A64 (pos. 8) A65 (pos. 6) A66 (pos. 4) A67 (pos. 2)	Adjust in order given for max. output.
"	"	A68 (pos. 8)	Adjust for max. output.
"	"	A69 (pos. 16)	Adjust for max. output. Repeat steps 24, 25, & 26 until no further improvement can be made.
"	"	A70 (pos. 8) A71 (pos. 6) A72 (pos. 4) A73 (pos. 2)	Adjust in order given for max. output.
"	"	A74 (pos. 7)	Adjust for max. output.
"	"	A75 (pos. 16)	Adjust for max. output. Repeat steps 27, 28, & 29 until no further improvement can be made.
"	"	A76 (pos. 7) A77 (pos. 5) A78 (pos. 3) A79 (pos. 1)	Adjust in order given for maximum output.
"	"	A80 (pos. 8) A81 (pos. 6) A82 (pos. 4) A83 (pos. 2)	"
"	"	A84 (pos. 16) A85 (pos. 13) A86 (pos. 11) A87 (pos. 9)	Adjust in order given for maximum output. Repeat steps 30, 31 and 32 until no further improvement can be made.
"	"	A88 (pos. 8) A89 (pos. 6) A90 (pos. 4) A91 (pos. 2)	Adjust in order given for maximum output.
"	"	A92 (pos. 7) A93 (pos. 5) A94 (pos. 3) A95 (pos. 1)	"
"	"	A96 (pos. 16) A97 (pos. 13) A98 (pos. 11) A99 (pos. 9)	Adjust in order given for maximum output. Repeat steps 33, 34 and 35 until no further improvement can be made.
"	"	A100 (pos. 7) A101 (pos. 6) A102 (pos. 4) A103 (pos. 2)	Adjust in order given for maximum output.
"	"	A104 (pos. 5) A105 (pos. 3) A106 (pos. 1) A107 (pos. 1)	"
"	"	A108 (pos. 16) A109 (pos. 13) A110 (pos. 11) A111 (pos. 9)	Adjust in order given for maximum output. Repeat steps 36, 37 and 38 until no further improvement can be made.
"	"	A112 (pos. 7) A113 (pos. 5) A114 (pos. 3) A115 (pos. 1)	Adjust in order given for maximum output.
"	"	A116 (pos. 8) A117 (pos. 6) A118 (pos. 4) A119 (pos. 2)	"
"	"	A120 (pos. 16) A121 (pos. 13) A122 (pos. 11) A123 (pos. 9)	Adjust in order given for maximum output. Repeat steps 39, 40 and 41 until no further improvement can be made.

## BAND SPREAD OSC. & RF ALIGNMENT

It is important that general coverage alignment be performed before bandspread alignment, since general coverage alignment affects bandspread alignment. General coverage alignment is not affected by bandspread alignment, so if only bandspread alignment is required it may be performed separately. The need for oscillator alignment of any band is indicated by the main tuning dial being off more than 5 divisions in either direction. The pre-alignment settings of the receiver controls are the same as for general coverage alignment, EXCEPT, that the bandspread switch on each coil set must be switched to **BANDSPREAD**. The low frequency tracking may be checked by making a slight adjustment of the trimmer capacitors at positions 1, 3 and 5. A slight change in either direction should decrease the output. The trimmers should be reset at the high frequency end of each band.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	BAND SWITCH POS.	RADIO DIAL SETTING	OUTPUT METER	ADJUST	REMARKS
42. 270Ω Carbon Resistor	High side thru 270Ω to antenna terminal. Low side to chassis.	30MC (400%Mod)	Plug in Coil Set "A"	30MC	Across out- put terminals	A124 (pos. 7) A125 (pos. 5) A126 (pos. 3) A127 (pos. 1)	Adjust in order given for maximum output.
43. "	"	27.2MC	"	27.2MC	"	A128 (pos. 15) A129 (pos. 14) A130 (pos. 12) A131 (pos. 10)	Adjust in order given for maximum output. Repeat steps 42 and 43 until no further improvement can be made.
44. "	"	14.4MC	Plug in Coil Set "B"	14.4MC	"	A132 (pos. 7) A133 (pos. 5) A134 (pos. 3) A135 (pos. 1)	Adjust in order given for maximum output.
45. "	"	14MC	"	14MC	"	A136 (pos. 15) A137 (pos. 14) A138 (pos. 12) A139 (pos. 10)	Adjust in order given for maximum output. Repeat steps 44 and 45 until no further improvement can be made.
46. "	"	7.3MC	Plug in Coil Set "C"	7.3MC	"	A140 (pos. 7) A141 (pos. 5) A142 (pos. 3) A143 (pos. 1)	Adjust in order given for maximum output.
47. "	"	7.0MC	"	7.0MC	"	A144 (pos. 15) A145 (pos. 14) A146 (pos. 12) A147 (pos. 10)	Adjust in order given for maximum output. Repeat steps 46 and 47 until no further improvement can be made.
48. "	"	4.0MC	Plug in coil set "D"	4.0MC	"	A148 (pos. 7) A149 (pos. 5) A150 (pos. 3) A151 (pos. 1)	Adjust in order given for maximum output.
49. "	"	3.5MC	"	3.5MC	"	A152 (pos. 15) A153 (pos. 14) A154 (pos. 12) A155 (pos. 10)	Adjust in order given for maximum output. Repeat steps 48 and 49 until no further improvement can be made.

## FIRST RF STAGE ALIGNMENT WITH LOW IMPEDANCE TRANSMISSION LINE

If a low impedance transmission line is used with this receiver, it may be necessary to align the 1st. RF Amplifier at the high frequency end of each band. To check for this possibility rotate the antenna trimmer control. The presence of two distinct peaks in output indicate that the RF Amplifier is tracking properly. Lack of a peak or presence of only one peak indicates improper tracking and need for correction.

## GENERAL COVERAGE ADJUSTMENTS

Set the band spread switches on each coil set to be aligned to general coverage.  
Set the control switch to **AM**.  
Set the selectivity switch to **OFF**.  
Set antenna trimmer control knobs so the arrow points straight up towards top of set.  
Set the **AF** gain control at "10".  
Set the **RF** gain to a suitable listening volume.  
Coil sets A, D, E and G do not use a 1st. RF Amplifier general coverage trimmer, but are peaked by the antenna trimmer control over the full range of the coil set.  
Connect the antenna feeders to the receiver antenna terminals and tune the receiver to the signal frequency first shown in the general coverage Osc. & RF Alignment table for each coil set (Coil set "A", 30MC, coil set "B", 7MC, etc.).  
Peak trimmers as follows for maximum signal, or if no signal is available, for maximum background noise.

Coil Set A	Adjust Ant. Trimmer Control
Coil Set B	Adjust A27 (pos. 4)
Coil Set C	Adjust A34 (pos. 4)
Coil Set D	Adjust Ant. Trimmer Control
Coil Set E	Adjust Ant. Trimmer Control
Coil Set F	Adjust A54 (pos. 2)
Coil Set G	Adjust Ant. Trimmer Control
Coil Set H	Adjust A65 (pos. 2)
Coil Set J	Adjust A71 (pos. 1)
Coil Set AA	Adjust A77 (pos. 1)
Coil Set AB	Adjust A89 (pos. 2)
Coil Set AC	Adjust A101 (pos. 2)

## BANDSPREAD ADJUSTMENTS

Set the bandspread switches on each coil set to be aligned to bandspread position.  
Set the receiver controls in the same manner as general coverage.  
Connect the antenna feeders to the receiver antenna terminals, and tune to the signal frequency first shown on the bandspread Osc. & RF adjustment table for each coil set.  
Peak the trimmers as follows for maximum signal, or if no signal is available for maximum background noise.

Coil Set A	Adjust A125 (pos. 1)
Coil Set B	Adjust A133 (pos. 1)
Coil Set C	Adjust A141 (pos. 1)
Coil Set D	Adjust A149 (pos. 1)

## S-METER ADJUSTMENT

The "S" meter balancing resistor R5 is used to obtain zero meter reading in the absence of signal.  
Set the **RF** gain control at "0".  
Set the **AVC** switch to **AVC**.  
Set the control switch to **AM**.  
Adjust R5 until "S" meter reads zero.

# PARTS LIST AND DESCRIPTIONS

TUBES (SYLVANIA or Equivalent)

ITEM No.	USE	REPLACEMENT DATA		RTMA BASE TYPE	NOTES
		NATIONAL PART No.	STANDARD REPLACEMENT		
V1	1st RF Amplifier	6BA6	6BA6	7BK	
V2	2nd RF Amplifier	6BA6	6BA6	7BK	
V3	H.F. Oscillator	6C4	6C4	6BG	
V4	Mixer	6BE6	6BE6	7CH	
V5	Converter	6BE6	6BE6	7CH	
V6	1st IF Amplifier	6SG7	6SG7	8BK	
V7	2nd IF Amplifier	6SG7	6SG7	8BK	
V8	3rd IF Amplifier	6SG7	6SG7	8BK	
V9	C.W. Oscillator	6H6	6H6	8N	
V10	Detector-AVC	6H6	6H6	8N	
V11	Noise Limiter	6H6	6H6	8N	
V12	AF Amplifier	6H6	6H6	8N	
V13	Phase Inverter	6H6	6H6	8N	
V14	"B" Meter Amp.	6H6	6H6	8N	
V15	Audio Output	6V6GT	6V6GT	8BD	
V16	Rectifier	5V4G	5V4G	7S	
V17	Voltage Reg.	5V4G	5V4G	5L	
V18	Current Reg.	4H-4	4H-4		

## CAPACITORS

Capacity values given in the rating column are in mfd. for Electrolytic and Paper Capacitors, and in mmfd. for Mica and Ceramic Capacitors.

ITEM No.	RATING CAP. VOLTS	REPLACEMENT DATA				NOTE
		NATIONAL PART No.	AEROVOX PART No.	CORNEILL-DUBILLIER PART No.	ERIE PART No.	
C1A	40	K945-3	APR2-72	BO53	FP262	TVL-2830
C2	40	E338-4	PR550/25	BR255A	TC36	TVA-1306
C3	25	E338-4	PR550/25	BR255A	TC36	TVA-1306
C4	10000	K946-2	BPD-01	TM581	DC-511	5HK-S1
C5	10000	K946-2	BPD-01	TM581	DC-511	5HK-S1
C6	1	400	1494-01	PTE4P1	MC475	4TM-P1
C7	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C8	5000	400	1217-29	PTE4P1	DC-525	5HK-D5
C9	5000	400	1217-29	PTE4P1	DC-525	5HK-D5
C10	5000	400	1217-29	PTE4P1	DC-525	5HK-D5
C11	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C12	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C13	5000	400	1217-29	PTE4P1	DC-525	5HK-D5
C14	5000	400	1217-29	PTE4P1	DC-525	5HK-D5
C15	5000	400	1217-29	PTE4P1	DC-525	5HK-D5
C16	5000	400	1217-29	PTE4P1	DC-525	5HK-D5
C17	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C18	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C19	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C20	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C21	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C22	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C23	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C24	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C25	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C26	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C27	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C28	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C29	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C30	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C31	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C32	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C33	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C34	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C35	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C36	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C37	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C38	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C39	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C40	5000	400	1217-35	PTE4P1	DC-525	5HK-D5
C41	5000	400	1217-35	PTE4P1	DC-525	5HK-D5

# PARTS LIST AND DESCRIPTIONS (Continued)

RESISTORS (CONT.)

ITEM No.	RATING OHMS	WATT	REPLACEMENT DATA		NOTES
			NATIONAL PART No.	IRC PART No.	
R47	220K	1/2	J569-53	BTS-220K	
R48	470K	1/2	J569-57	BTS-470K	
R49	220K	1/2	J569-53	BTS-220K	
R50	220K	1/2	J569-53	BTS-220K	
R51	220K	1/2	J569-53	BTS-220K	
R52	1500	1/2	J569-15	BTS-1500	
R53	470K	1/2	J569-57	BTS-470K	
R54	100K	1/2	J569-10	BTS-100K	
R55	470K	1/2	J569-57	BTS-470K	
R56	220K	1/2	J569-53	BTS-220K	
R57	220K	1/2	J569-53	BTS-220K	
R58	470K	1/2	J569-57	BTS-470K	
R59	470K	1/2	J569-57	BTS-470K	

Note 1. May be from 100Ω to 1000Ω. Individually chosen to meet the requirements of each receiver.  
Note 2. Some Models use a 150Ω resistor in this application.

## TRANSFORMER (POWER)

ITEM No.	RATING	REPLACEMENT DATA		NOTES
		NATIONAL PART No.	STANCOR PART No.	
T1	117VAC 550VCT 5VAC @ 4.6A 130ADC @ 3A 230VAC	SA9209		

## TRANSFORMER (AUDIO OUTPUT)

ITEM No.	RATING	REPLACEMENT DATA		NOTES
		NATIONAL PART No.	STANCOR PART No.	
T2	8.2KΩ 500Ω CT 312HCT 210 Tap @ 660	PI87-1		

## FILTER CHOKE

ITEM No.	RATING	REPLACEMENT DATA		NOTES
		NATIONAL PART No.	STANCOR PART No.	
L1	0.065A 2900Ω 17HY	SA1694		

## COILS (RF-IF)

ITEM No.	USE	REPLACEMENT DATA		NOTES
		NATIONAL PART No.	STANCOR PART No.	
L2A	Ant. Trans.	SA-3363		A Band, 14-30MC
L2B	Ant. Trans.	SA-3363		B Band, 7-14.4MC
L2C	Ant. Trans.	SA-3363		C Band, 3.5-7.3MC
L2D	Ant. Trans.	SA-3363		D Band, 1.7-4MC
L2E	Ant. Trans.	SA-3363		E Band, 900-2050KC
L2F	Ant. Trans.	SA-3363		F Band, 480-960KC
L2G	Ant. Trans.	SA-3363		G Band, 180-420KC
L2H	Ant. Trans.	SA-3363		H Band, 100-200KC
L2I	Ant. Trans.	SA-3363		I Band, 50-100KC
L2J	Ant. Trans.	SA-3363		J Band, 27-30MC
L2K	Ant. Trans.	SA-3363		AA Band, 95-35MC
L2L	Ant. Trans.	SA-3363		AB Band, 91-21.5MC
L2M	Ant. Trans.	SA-3363		AC Band, 50-54MC